INSTRUCTOR INFORMATION

Sound Level Meter

LEARNING OBJECTIVES

- Supplement classroom instruction of sound and its effects with hands on engineering application.
- Control devices (e.g., lights, motors, buzzers) based on input from measured physical quantities (e.g., sound level).

RECOMMENDED GRADES/SUBJECTS

Grades 6–12/Physical Science, Chemistry, Biology, or Physics

TIME NEEDED

The project is designed to be completed in one 45-minute period.

RELATED EXPERIMENTS

"Sound Waves and Beats" – Experiment 32 from *Physics with Vernier*

NEXT GENERATION SCIENCE STANDARDS (NGSS)

Disciplinary Core Ideas	Crosscutting Concepts	Science and Engineering Practices
ETS1.A. Defining and Delimiting Engineering Problems ETS1.B. Developing Possible Solutions ETS1.C. Optimizing the Design Solution	Patterns Cause and effect Scale, proportion, and quantity Systems and system models	Asking questions and defining problems Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations and designing solutions Engaging in argument from evidence Obtaining, evaluating, and communicating information

INFORMATION FOR THE INSTRUCTOR

For students to be successful in this extension activity, they need to be somewhat familiar with two processes: the Engineering Process and running the Digital Control Unit (DCU). In addition to the information in this document, we have provided the following resources:

- Introduction to Engineering Design: This document includes a brief introduction to the engineering design process and an example of an Engineering Design Sheet. The Design Sheet is a great way to help your students organize their time and efforts. It also provides you with a way to assess student progress and learning.
- Sound Level Meter – Example Design Sheet (Word® document): A completed Design Sheet that will help you integrate the use of Engineering Design Sheets in your classroom
- Sound Level Meter – Example LP file: An example Logger *Pro* experiment file for this activity that will help you better understand how to program Logger *Pro* to run the DCU
- DCU Tips – Background information about using the DCU, programming it in Logger *Pro* and LabQuest 2, and general troubleshooting tips for the DCU.

In the remainder of this document you will find additional resources to help you successfully integrate this engineering extension activity into your course:

- Follow Up Questions: A few reflection questions to help your students better understand the engineering process and to help you assess their learning
- Challenge Activities: Additional activities for advanced students
- Supplemental Student Instructions: Additional instructions you can give to students if this is their first time using the DCU with Logger *Pro* or LabQuest 2 app

Follow Up Questions

Engineering extension activities usually require a different assessment than a traditional lab. We suggest that you create a rubric for grading the Engineering Design Sheet. Additionally, use follow up questions, such as those below, to help students reflect on the engineering process and to help you evaluate their learning:

- Explain a design decision you made in which you had to choose from multiple ideas. How did you make your choice? Why?
- Justify your choices for the output device. Why did you choose to indicate the sound level using this device? What advantages does it have over an alternative?
- What do you see as the strengths or weaknesses of your sound level meter? What changes would you make in the next version?

Challenge Activities

If your students need more of a challenge, provide them with one or more of the following options:

- Allow the user to adjust the acceptable sound level using the User Parameters feature in Logger *Pro*.
- Rather than just signaling when the sound level is too loud, indicate when the sound level is close to the threshold, i.e. there are three states (OK, getting noisy, and too loud) rather than just two (OK and too loud).
- Use multiple sound level meters and indicators to identify which part of the classroom is too loud.

Supplemental Student Instructions

We feel that the student sheets present engaging challenges. However, depending on your emphasis for this project and the level of your students, you may wish to provide them with more detailed instructions on various aspects of the software and logic setup as included below.

Equipment Setup

1. Connect the Green LED and its resistor between D1 and GND on the DCU. Connect the Red LED and its resistor between D2 and GND on the DCU. In both cases, connect the positive LED lead to the digital line and the negative LED lead to its matching resistor. Connect the other end of the resistor to the GND lead on the DCU.

   Tip: *LEDs have polarity. If the two leads are of different length, the longer one will be the positive or anode lead. If there is a flat side on the plastic housing, the lead near the flat is the negative, or cathode, lead.*

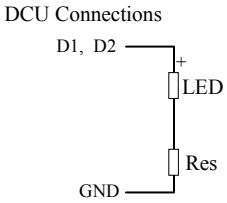

Figure 1

2. Connect a power supply to the DCU.

3. Connect the DCU to the first digital (DIG) port on the interface and the Sound Level Meter to CH 1.

4. Connect the interface to the computer. If the interface has a power switch, turn it on.

Software Setup - Logger *Pro*

1. Start Logger *Pro*.

2. Choose Set Up Sensors from the Experiment menu and select your interface from the list.

3. Click the DIG/SONIC1 button and select Digital Out.

Figure 2

4. First check your hardware set up. If you check the Line 1 On box, the Green LED should light up. If you check the Line 2 On box, the Red LED should light. Fix any problems and uncheck all boxes.

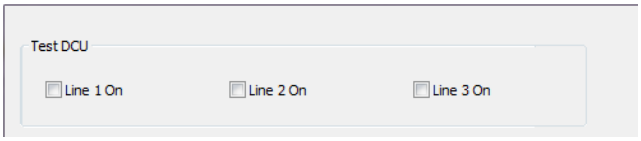

Figure 3

5. Configure the three output lines as shown in Figure 4.

Figure 4

6. Select the option to Start activation when experiment run is started. Select OK.

7. Close the Set Up Sensors window.

Software Setup - LabQuest 2

1. Start your LabQuest 2, connect the DCU to one of the DIG ports and your sensor to one of the CH ports.

2. Choose the Sensors tab from the app and select DCU Setup and select the DCU from the list.

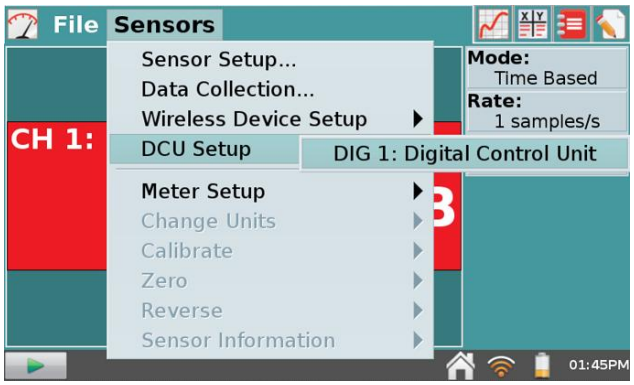

Figure 5

3. First test your hardware setup. The green LED on your DCU should light up when the DCU is connected. If you check the box next to Line 1 On, the corresponding red LED on the DCU should light up. Check the other lines as necessary. Fix any problems and uncheck all boxes.

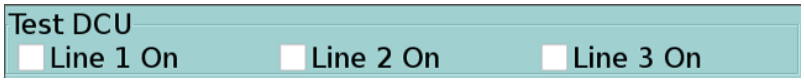

Figure 6

4. Configure two of the three output lines as shown in Figure 7.

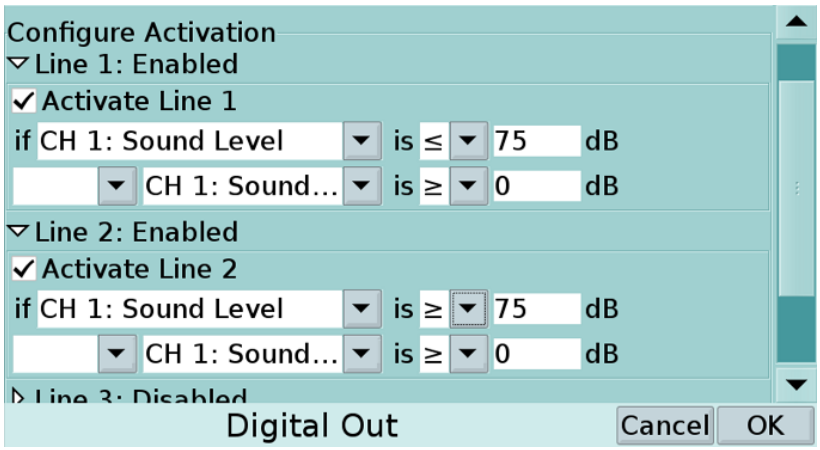

Figure 7

5. Select the option to Start activation when experiment run is started. Select OK.